

Section C

Statement of Work

For Manufacturing and Qualification Tests Of

Laminac Binder Replacement in Pyrotechnic Compositions for

Handheld Signals

C. 1.0. SCOPE

Laminac 4116 is used as a binder material in several pyrotechnic munitions, including Hand Held Signals. There are several issues involved with the use of this binder material including environmental and health hazardous concerns. Alternate and environmentally compatible binder materials will be tested, evaluated, down-selected and optimized without compromising the performance characteristics of the handheld signal system

C. 1.1. BACKGROUND

Laminac 4116 binder material is presently used in the pyrotechnic compositions. Laminac is a polyester base resin that cross-links to a thermoset copolymer with a vinyl monomer, styrene. Lupersol DDM-9 serves as a catalyst for the polyester resin cross-linking and contains methyl ethyl ketone peroxide (MEKP). There are several issues involved with the use of this system. First, both, the carrier solvent-styrene and MEKP are toxic materials and are extremely hazardous to health and environment. Load plants have complaints about these materials. Secondly, the cross-linking and thermosetting nature of the binder often lead to the volume of consolidation of illuminating compositions to shrink during cure, resulting inconsistent candle power/burn time and charge fall out during field testing. Thirdly, Laminac has limited pot life when incorporated with the cure agent, forcing manufacturers to blend a mix and press it within a very short time. Finally, this material can be obtained only from a single source and has limited military and commercial market. The overall approach addressed in this program is to explore the use of an alternate binder material without compromising the performance characteristics of the signal system

A broad-based search from government, industry and academia was applied to gather information on alternate materials for Laminac systems. Potential candidates were selected for evaluation based on the following criteria - environmental acceptability (toxicity characteristics), solubility in solvent, tensile strength, soft point/decomposition temperature (thermal stability), commercial availability, compatibility with pyrotechnic ingredients and requirement for curing/cross linking.

This work will perform function and visual tests of candles and complete signals produced with different binder materials (POLIVIC-S202, UC-AYAF, Alcotex 359B) using standard magnesium compositions and compared with the samples prepared with the Laminac 4116 binder to determine if this material can be used to meet requirements for M125A1, M126A1 and M127A1. M158, M159 and M195 Hand Held Signals.

C. 2.0 APPLICABLE DOCUMENTS

C. 2.1 Spec

Military Specification MIL-S-13257H (AR)

Military Specification MIL-S-13261F/G (AR),

C 2.2 Drawings

8797956 - M125A1 Illuminant Assembly

8797920 –M125A1, M158, M159 Signal, ground, illuminant, cluster Assembly

8797981 – M127A1 Illuminant Assembly

8797971 - M126A1 Illuminant Assembly

8797968 - Red star M126A1 & White star M127A1 Signal, ground, parachutes Assembly

8839489 - M158 Red star & M159 White star Illuminant Assembly

9255113 - M195 Ground, Parachute, Green star Illuminant Assembly

C. 2.3 MSDS for Polyvinyl acetate resins (UC-AYAF, Dow Chemical, <fgpubl@dow.com>, Ph: 800-447-4369

Vinyl alcohol acetate resin (Polivic S202, 3V Inc. Plastic Div, Ph: 201-865-3600)

Vinyl alcohol acetate resin (Alcotex 359B, Synthomer/FOCUS Chem Corp. Stuart M. Aronson, Ph: 732-679-8067)

C.3.0 REQUIREMENTS

C.3.1 Phase 1A: Manufacture Illuminant Assemblies

Candidate binders to be tested are Polyvinyl acetate resins (UC-AYAF), Vinyl alcohol acetate resin (Polivic S202), Vinyl alcohol acetate resin (Alcotex 359B) and Laminac 4116 (control)

Candidate Hand Held Signals to be tested are M125A1 Signal, ground, green star cluster M126A1 Signal, ground, parachutes red star & M127A1 Signal, ground, parachutes white star

Manufacture maximum three mixtures (batches) of illuminant composition with different binder concentrations for each binder and one (1) control batch of standard Laminac illuminant compositions. Manufacture minimum of twenty (20) illuminant assemblies for each batch. Total batches per signal (3X3 +1 (control)) are 10. For three signals total batches are 30.

C.3.2 Phase 1B: Prove out signal output, light intensity, and color.

Perform static burn test in accords with Paragraph 4.5.10, MIL-S-13257H (AR)/ MIL-S-13261F/G (AR), in which the twenty (20) illuminant assemblies from each batch shall be tested. Manufacture 20 illuminant assemblies of standard composition as a control group. Testing will be repeated until satisfactory results are met of the spec. Total illuminant assemblies to be tested per signal (60X3 + 20X1 (control) are 200. For three signals total illuminant assemblies (3X200) to be tested are 600.

C.3.3 Phase 1C: Selection of Binders

Once a satisfactory composition is determined from phase1A & 1B test results select a minimum of two best performing binders for each HH Signal for follow on testing.

C.3.4 Phase 1D: Repeatability of Signal Light Output

Once a satisfactory composition is determined, three batches of the same composition for each binder shall be manufactured and loaded into Illuminate assemblies and shall be tested per 4.5.10 (Static burn test) of MIL-S-13257H / MIL-S-13261F/G (AR) as appropriate. Total batches per signal (2X3) are 6 and for three signals total batches (3X6) are 18. For three signals total illuminant assemblies (18X20) to be tested are 360

C.3.5 Phase 1E: Manufacture Complete Signals for Function Tests

Perform Signal assemblies for function test and visual test per MIL-S-13257H / MIL-S-13261F/G (AR) as appropriate. Assemblies shall be tested for hot, ambient and cold temperatures in accordance with paragraph 4.5.2.1, 4.5.2.2, 4.5.2.3 and 4.5.10 of MIL-S-13257H / MIL-S-13261F/G (AR) as appropriate. Total batches for two selected binders (larger quantity) per signal = 2. Total illuminant assemblies to be produced for the two selected binders per signal are (2X100=200) and out of which (2X80=160) complete signals are produced for function testing. Total large quantity batches for three signals (3X2) are 6 and total illuminant assemblies to be produced for the two selected binders (3X200) are 600 and total complete signals (3X2X80) to be produced are 480 for function testing.

C.3.6 Phase 2A: Manufacture Illuminant Assemblies

Candidate binders to be tested are Polyvinyl acetate resins (UC-AYAF), Vinyl alcohol acetate resin (Polivic S202), Vinyl alcohol acetate resin (Alcotex 359B) and Laminac 4116 (control)

Candidate Hand Held Signals to be tested are M195 Signal, ground, green star cluster, M158 Signal, ground, parachutes red star & M159 Signal, ground, parachutes white star

Manufacture two or three mixtures (batches) of illuminant composition with different binder concentrations for each binder and one (1) control batch of standard Laminac illuminant compositions. Manufacture the twenty (20) illuminant assemblies for each batch. Total batches per signal ($3 \times 3 + 1$ (control)) are 10. For three signals total batches are 30.

C.3.7 Phase 2B: Prove out signal output, light intensity, and color.

Perform static burn test in accords with Paragraph 4.5.10, MIL-S-13257H (AR)/ MIL-S-13261F/G (AR), in which the twenty (20) illuminant assemblies from each batch shall be tested. Manufacture another batch of standard composition as a control group. Testing will be repeated until satisfactory results are met of the spec. Total illuminant assemblies to be tested per signal ($60 \times 3 + 20 \times 1$ (control)) are 200. For three signals total illuminant assemblies (3×200) to be tested are 600.

C.3.8 Phase 2C: Selection of Binders

Once a satisfactory composition is determined from phase 2A & 2B test results select a minimum of two best performing binders for each HH Signal for follow on testing.

C.3.9 Phase 2D: Repeatability of Signal Light Output

Once a satisfactory composition is determined, three batches of the same composition for each binder shall be manufactured and loaded into Illuminate assemblies and shall be tested in accordance with paragraph 4.5.10 (Static burn test) of MIL-S-13257H / MIL-S-13261F/G (AR) as appropriate. Total batches per signal (2×3) are 6 and for three signals total batches (3×6) are 18. For three signals total illuminant assemblies to be tested (18×20) are 360

C.3.10 Phase 2E: Manufacture Complete Signals for Function Tests:

Perform Signal assemblies for function test and visual test per MIL-S-13257H / MIL-S-13261F/G (AR) as appropriate. Assemblies shall be tested for hot, ambient and cold temperatures in accordance with paragraph 4.5.2.1, 4.5.2.2, 4.5.2.3 and 4.5.10 of MIL-S-13257H / MIL-S-13261F/G (AR) as appropriate. Total batches for two selected binders (larger quantity) per signal = 2. Total illuminant assemblies to be produced for the two selected binders per signal are ($2 \times 100 = 200$) and out of which ($2 \times 80 = 160$) complete signals are produced for function testing. Total large quantity batches for three signals (3×2) are 6 and total illuminant assemblies to be produced for the two selected binders are (3×200) 600 and total complete signals ($3 \times 2 \times 80$) to be produced are 480 for function testing.

C.3.11 Final Report

Prepare final reports on all Phases I - 3 of the scope of Work. The reports should include details of processing procedures with new binder materials, problems encountered, solution provided and other pertinent details and any additional recommendations in the production of illuminant compositions for Hand Held Signals

C.3.12 Monthly Reports

Prepare a Status Report each month of the program. This report will describe progress during the reporting period, any problems and funding Status.

C.3.13 Duration of Work

Not to exceed twelve (12) months from the contract award date.

**TABLE 1: Tentative Test Plan for Laminac Replacement Binders for Hand Held Signals
(Required Tests per Binder per Signal)**

Requirements (per SOW)	Per Binder per Signal		Quantities for tests	Test Per Mil-Spec*
C.3.1: Three New Binders: * Polivic S202, Alcotex 359, UC-AYAF (Control) # Laminac 4116	Per Binder - Prepare three batches as necessary (different concentration) to obtain the required performance	Batch 1	N/A	N/A
		Batch 2	N/A	N/A
		Batch 3	N/A	N/A
		Control Batch (Laminac)	N/A	N/A
	Illum Tests per binder	Batch 1	20	4.5.10
C.3.2 Prove-Out signal output, light intensity & color per Mil-Spec.		Batch 2	20	4.5.10
		Batch 3	20	4.5.10
		Control	20	4.5.10
C.3.3 - Selection by ARDEC/Vendor - Best Two Binders from C.3.1 & C.3.2 Results				
C.3.4 - Production Repeatability Of the best composition & Performance of Signal output, light intensity & color per Mil-Spec.	Per Selected Binder	Batch 1	N/A	N/A
		Batch 2	N/A	N/A
		Batch 3	N/A	N/A
	Illum Test	Batch 1	20	4.5.10
	Illum Test	Batch 2	20	4.5.10
	Illum Test	Batch 3	20	4.5.10
	C.3.5: Qualification Tests (FAT) Prepare per Selected Binder- (One LOT) Produce Illum assembly, Complete Signal Assembly & Perform Signal Function / Visual Tests per Mil-Spec.	(Illum assy) Signal (hot) Signal (ambient) Signal (cold-fixtue fired)	20	4.5.10
32			4.5.2.1	
32			4.5.2.2	
16			4.5.2.3.1	

SUMMARY: Total flare compositions batches including six large quantity batches = 108.

Total flares to be produced = 3,120.

Total complete signals to be produced for function testing = 960

Hand Held Signals: M125A1, M26A1, M127A1, M158, M159, M195 * Mil-S-13261F/G or Mil -S-13257H
Binders to be tested: # Laminac 4116 (control), Ashland, Composite Polymer Div, Ph: 614-790-3818/4466

*Polivic S202 (3V Inc. Plastic Div, Ph: 201-865-3600),

*Alcotex 359 (Synthomer/FOCUS Chem Corp. -POC: Stuart M. Aronson, Ph: 732-679-8067)

*UC-AYAF (Dow Chemical, <fgpubl@dow.com>, Ph: 800-447-4369); Selection Two (2) out of three (3) new binders for C3.3-C3.5 testing; # Refer Drawings for composition of signals; information from SOW for new binders